Sub A

1. An improved method of correcting for atmospheric effects on a remote image of the Earth's surface taken from above, wherein the image comprises a number of images of the same scene each including a large number of pixels, each at a different wavelength band, and including infrared through visible wavelengths, comprising:

providing a radiation transport model that relates spectral radiance to spectral reflectance via a set of parameters;

providing a discrete number of trial visibility values;

using the radiation transport model to calculate the model parameter values for each of the trial visibilities;

selecting image pixels having a presumed, predefined ratio of reflectances in two different wavelength bands;

using the radiation transport model parameters to determine the surface reflectance for the selected image pixels for each of the two selected wavelength bands for each trial visibility;

comparing the determined surface reflectances to the predefined ratio of reflectances;

determining from the comparison the differences between the determined reflectances and the ratio-predicted reflectances for one of the two selected wavelength bands; and

resolving from the differences a corrected image visibility value.

2. The method of claim 1, in which using the radiation transport model to calculate the model parameter values includes performing calculations for the specific geometric conditions

of solar illumination and sensor viewing that apply to the image being analyzed.

3. The method of claim 1, in which using the radiation transport model to calculate the model parameter values includes performing calculations for a plurality of geometric conditions of solar illumination and sensor viewing, storing the calculation results, and interpolating the stored results to the specific geometric conditions that apply to the image being analyzed.

4. The method of claim 1, in which using the radiation transport model to calculate the model parameter values includes performing calculations of the radiance from the surface that is scattered into the sensor by weighting the spectra from different parts of the surface according to their contributions to each pixel.

5. The method of claim 1, in which the radiation transport model includes MODTRAN.

6. The method of claim 1, in which the sensor viewing angle is nadir.

7. The method of claim 1, in which the sensor viewing angle is off-nadir.

8. An improved method of correcting for atmospheric effects on a remote image of the Earth's surface taken from above, wherein the image comprises a number of simultaneously acquired images of the same scene, each including a large number of pixels, each at a different wavelength band, and including infrared through ultraviolet wavelengths, comprising:

providing a radiation transport model that relates spectral radiance to spectral reflectance via a set of parameters;

providing a discrete number of trial column water vapor amounts;

using the radiation transport model to calculate the model parameter values for each of

the trial column water vapor amounts at wavelengths within and outside at least one water vapor absorption band;

initially determining the column water vapor amount for each pixel from comparisons of the observed radiances at those wavelengths within the calculations based on the model parameters for each trial column water amount;

determining pixels that likely include a cloud, by performing on each pixel a brightness test, a color balance test, and a low-water test, and for such pixels that pass these tests;

replacing the actual radiance with a presumed radiance;

resolving the visibility value for the image;

refining the determined column water vapor amounts for the pixels using the resolved visibility value; and

determining the reflectance of each image pixel.

9. The method of claim 8, in which using the radiation transport model to calculate the model parameter values includes performing calculations for the specific geometric conditions of solar illumination and sensor viewing that apply to the image being analyzed.

10. The method of claim 8, in which using the radiation transport model to calculate the model parameter values includes performing calculations for a plurality of geometric conditions of solar illumination and sensor viewing, storing the calculation results, and interpolating the stored results to the specific geometric conditions that apply to the image being analyzed.

11. The method of claim 8, in which using the radiation transport model to calculate the model parameter values includes performing calculations of the radiance from the surface that

is scattered into the sensor by weighting the spectra from different parts of the surface according to their contributions to each pixel.

12. The method of claim 8, in which the radiation transport model includes MODTRAN.

13. The method of claim 8, in which the sensor viewing angle is nadir.

14. The method of claim 8, in which the sensor viewing angle is off-nadir.

15. An improved method of correcting for atmospheric effects on a remote image of the Earth's surface taken from above, wherein the image comprises a number of simultaneously acquired images of the same scene, each including a large number of pixels, each at a different wavelength band, and including infrared through ultraviolet wavelengths, comprising:

providing a radiation transport model that relates spectral radiance to spectral reflectance via a set of parameters;

dividing the image into a plurality of sub image areas, each comprising a plurality of pixels;

determining for each sub image area a blended water vapor column density;

for each sub image area, using the radiation transport model and the blended water vapor column density to determine a single value for several variables in the radiation transport model; and

calculating the surface reflectance for each pixel in each sub image area from the several variables determined for the sub image area in which the pixel is found, and the spectral radiance for the pixel.

16. The method of claim 15, in which using the radiation transport model to calculate the

model parameter values includes performing calculations for the specific geometric conditions of solar illumination and sensor viewing that apply to the image being analyzed.

17. The method of claim 15, in which using the radiation transport model to calculate the model parameter values includes performing calculations for a plurality of geometric conditions of solar illumination and sensor viewing, storing the calculation results, and interpolating the stored results to the specific geometric conditions that apply to the image being analyzed.

18. The method of claim 15, in which using the radiation transport model to calculate the model parameter values includes performing calculations of the radiance from the surface that is scattered into the sensor by weighting the spectra from different parts of the surface according to their contributions to each pixel.

19. The method of claim 15, in which the radiation transport model includes MODTRAN.

20. The method of claim 15, in which the sensor viewing angle is nadir.

21. The method of claim 15, in which the sensor viewing angle is off-nadir.

22. An improved method of correcting a shift in wavelength calibration of a two dimensional focal plane array used to capture a remote image of the Earth's surface taken from above, wherein the image comprises a number of simultaneously acquired images of the same scene, each including a large number of pixels, each at a different wavelength band, and including infrared through ultraviolet wavelengths, comprising:

providing a nominal channel wavelength calibration value for each channel in the image;

dividing the pixels into a plurality of strips, each corresponding to a narrow range of focal plane array cross-track pixel locations;

determining for each strip a set of sub-channel wavelength values that are derived from the nominal channel wavelength calibration values;

providing a radiation transport model that relates spectral radiance to spectral reflectance via a set of parameters;

calculating radiation model parameter values for each sub-channel; and

determining the reflectance of each image pixel using the calculated model parameter values.

23. The method of claim 22, in which calculating radiation model parameter values includes performing calculations for the specific geometric conditions of solar illumination and sensor viewing that apply to the image being analyzed.

24. The method of claim 22, in which using the radiation transport model to calculate the model parameter values includes performing calculations for a plurality of geometric conditions of solar illumination and sensor viewing, storing the calculation results, and interpolating the stored results to the specific geometric conditions that apply to the image being analyzed.

25. The method of claim 22, in which using the radiation transport model to calculate the model parameter values includes performing calculations of the radiance from the surface that is scattered into the sensor by weighting the spectra from different parts of the surface according to their contributions to each pixel.

26. The method of claim 22, in which the radiation transport model includes MODTRAN.

27. The method of claim 22, in which the sensor viewing angle is nadir.

28. The method of claim 22, in which the sensor viewing angle is off-nadir.

29. An improved method of correcting for atmospheric effects on a remote image of the Earth's surface taken from above, wherein the image comprises a number of images of the same scene each including a large number of pixels, each at a different wavelength band, and including infrared through ultraviolet wavelengths, comprising:

providing a radiation transport model that relates spectral radiance to spectral reflectance via a set of parameters;

providing a discrete number of trial aerosol visibility values and either trial aerosol property values or aerosol types;

using the radiation transport model to calculate the model parameter values for each of the trial aerosol visibility values;

selecting image pixels having a multiplicity of presumed, predefined ratios of reflectances among a multiplicity of wavelengths bands;

using the radiation transport model parameters to determine the surface reflectance for the selected image pixels for each of the multiplicity of wavelength bands for each combination of trial visibility value and trial aerosol property value or values, or aerosol type;

comparing the determined surface reflectances to the predefined ratios of reflectances; and

resolving from the comparison a combination of visibility value and aerosol property value or values or aerosol type for the corrected image.

30. The method of claim 29, in which the using the radiation transport model to calculate the model parameter values includes performing calculations for the specific geometric conditions of solar illumination and sensor viewing that apply to the image being analyzed.

31. The method of claim 29, in which using the radiation transport model to calculate the model parameter values includes performing calculations for a plurality of geometric conditions of solar illumination and sensor viewing, storing the calculation results, and interpolating the stored results to the specific geometric conditions that apply to the image being analyzed.

32. The method of claim 29, in which using the radiation transport model to calculate the model parameter values includes performing calculations of the radiance from the surface that is scattered into the sensor by weighting the spectra from different parts of the surface according to their contributions to each pixel.

33. The method of claim 29, in which the radiation transport model includes MODTRAN.

34. The method of claim 29, in which the sensor viewing angle is nadir.

35. The method of claim 29, in which the sensor viewing angle is off-nadir.